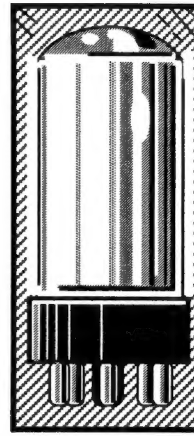
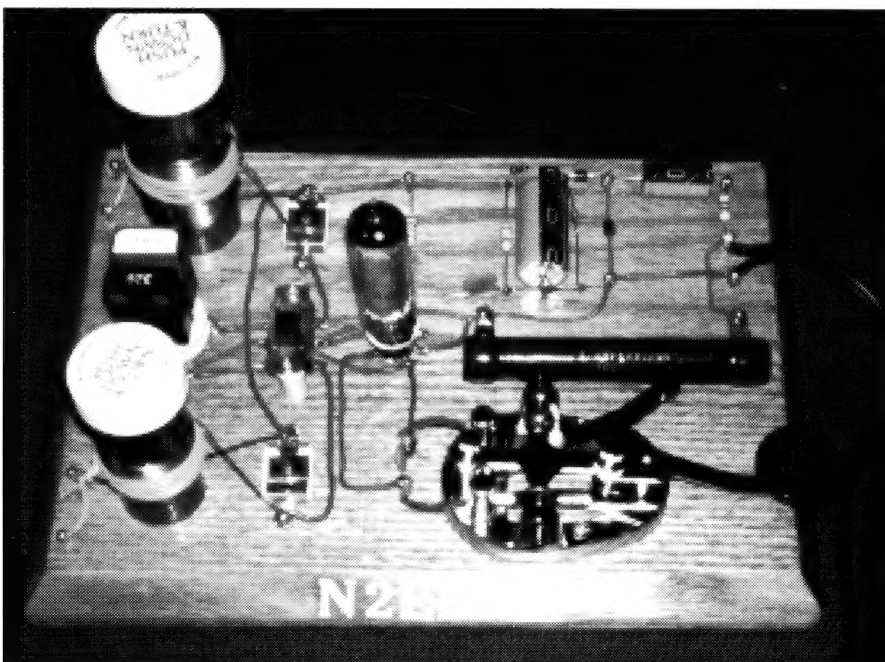
hambrew

FOR AMATEUR RADIO DESIGNERS AND BUILDERS

Tube Be Or Not Tube Be





N2EDF's 2-Bander

SPRING 1996

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Important

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• Contents •

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All others: Hambrew

hambrew

FOR AMATEUR RADIO DESIGNERS AND BUILDERS

SPRING, 1996 • VOL. 4, NO. 2

Publisher................George De Grazio, WFØK

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• LETTERS •

From The Publisher

Some days it definitely does not pay to get out of bed! Sheesh, what a surprise to suddenly realize that our long-since-dead 800 number is not only still on our renewal coupons, but also on our subscription expiration reminders! Add to this the fact that the label/database outfit which prints our labels put the "first issue" field on the Winter '96 labels instead of the "subscription expiration" field. Now the Winter '96 "expirants" have no clue on their labels that they (the subscriptions, not the subscribers) have expired! Oy! Well, we generated a good deal of confusion--sorry! Sure glad you know your expiration date!
70s, Geo., WFØK

I am a member of the N.E. VHF AM Wireless Society. Weekend mornings (we are) on 50.4 MHz, between 5:30 AM to 8:00 AM, using tube-rigs like HA460, Gonset Comm.2, etc.
I have put together a 6 meter Halo antenna using coax cable material, 67 inch circumference, and using a gamma match from the *V.H.F. Manual*, ARRL, 1965.
Mike Hickey, WA1CHP
Brookline, MA

Great, Mike! There's an idea: a homebrewed AM transmitter for 6 meters. I guess it would require a regular on-air meeting with a group like the one to which you belong to keep the tubes warm (if it were a tube-type rig), otherwise it would get no regular use. The idea of a regular net on 6 meters is one whose time has come, however. Perhaps a society like 10-10 for 6 meters could punch it up some. Plus, it would be a society which could include tech-plus members.

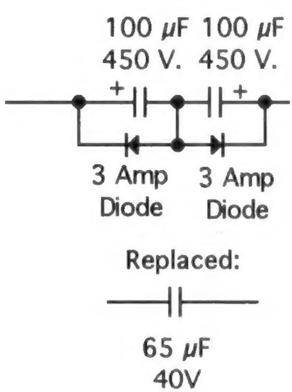
Thanks for a great magazine. It has been very helpful in learning about the basics and essence of ham radio.
Bob Roach, KE4QOK
Newport News, VA

I don't want to miss your *hambrew*, it is a must on every radio-amateur's workbench!
Theo van Geenen, PA3BNI
Delft, The Netherlands

Because QRP is small, is it really necessary that the circuit boards for kits be so TINY? Does a subminiature board really add to the functions of the board or does it add problems for some of us?
I know there are many whose confidence or hands or eyes are not really capable of handling the close spacing of parts on these mini-boards.
I am sure that many QRP rigs will never be back-packed to places where every ounce will be weighed. Give beginners and old folks a chance to build with less hassle and there will be more kits built.
If designers and editors were informed and helped get more builders started with less-hassle kits we all would have more fun . Try me. I would buy a 6 x 8" board, but not another 1.5 x 3".
Nate Bushnell, KDØUE
Littleton, Colorado

Hi George,
Many thanks for a great magazine. *Hambrew* is just what I was looking for. I wish I could get Spring of 1995 and the issues before Autumn, 1993. *(Autumn '93 was our very first issue - Ed.)* What happened to Dan's Small Parts in Missoula, MT? I was going to order the manuals for the NW80/20, but Dan's phone is no longer in service.
The NW80/20 reminds me of the Modular 2-Band Receiver (*Ham Radio*, July 1983, page 53) that I built a few years ago, only the NW80/

20 seems a lot less complicated. The digital frequency readout of the Modular Receiver is fairly simple and works good and I thought I might try it in the NW80/20...
I could not find a "Motor-Run Capacitor" for my antenna rotator control box, but I remembered an article in an old magazine did it this way:



All the parts were in my junk box. Maybe someone else can fix their rotator this easy way.
Thanks and 73,
Dan Salisbury, KE7IB
Redding, CA

Thanks, Dan, for the rotator info!
Regarding Dan's Small Parts and Kits, we have heard through the grapevine that there is a possibility that Dan's little business could re-open, possibly as soon as April, 1996. We emphasize that this information is not directly from Dan, so we cannot vouch for, though we hope for the veracity of, this rumor. He had a lot of great, hard to find parts at truly affordable prices, so we hope he gets the thing kick-started again!
As to the NW80/20, Emtech is now handling the kit, and it is available from them at 13848 SE 10th., Bellevue, WA 98005. See the ad on page 40 of this issue. SASE to Emtech if more info is desired.

...As a 69-year-old aspirer to a novice or technician-plus license, I find *Hambrew* a pleasure to read even though some of the whys-and wherefores of circuit hookups still mystify me.
Re: Mr. Lee's fine article on triansistor bias, I wonder if you could persuade him to come up with a short tutorial for novices in their dotage on additional electronic uses for the term "bias". I take it to be a pushing or pulling of current into a feedback loop, voltage divider, choke circuit, etc., in order to alter voltages, frequencies, impedances, etc...
Roland Jaworowski
Honolulu, HI

MOVING?

Notify us of your new address - don't miss a single issue of ***Hambrew!***

Back Issues of Hambrew:

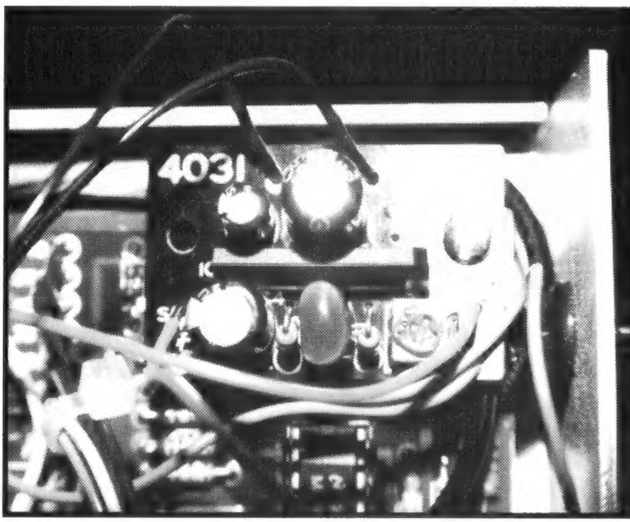
To keep your *Hambrew* collection complete, we still have a number of back issues available. Our Inaugural Issue was Autumn, '93. Back issues up to and including Fall, '94 are $6 each ($8 International), issues published after Fall, '94 are $3.50 ea. ($6 International) mailed in an envelope via first class mail. The Winter, Spring and Summer '95 Issues are sold out and are now collectors' items. Supplies of the other back issues are limited.

KIT REVIEW

An Inexpensive Audio Amp Kit

Marshall Emm, AA0XI / VK5FN

75230.1405@compuserve.com



The Radio Shack Amplifier Kit installed in the OHR SCAF Filter (photo: AAØXI).

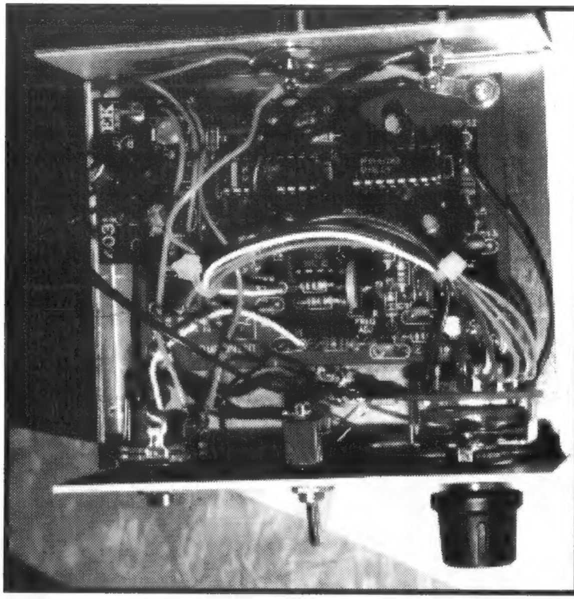
Radio Shack Power Amplifier Module Kit
RS Cat. No. 28-4031
$4.99

Features:

4-18VDC operation
Optional 26dB or 46dB gain
Output 1.1W at 12V
Idle current 5mA, 280mA at 1.1W
On-board input level control
1+" x 15/16ths (38 x 24mm) PCB

The Radio Shack audio amp kit is one of the best deals they've offered in a long time. Unfortunately, it won't last. One of the last three RS kits that actually requires a soldering iron, the amp kit has been *discontinued*. When this was written (early March) the kits were still available in some stores; when they're gone, they're gone. But if you can't buy the kit,don't despair. It's a very simple and commonly known circuit, and could easily be"ugly constructed" without a board.

Originally priced at $9.95, the RS audio amp is a surprisingly versatile unit. I've installed one in an Oak Hills Research SCAF Filter, where it sits on one of the mounting screws for the SCAF board, is powered from that board, and takes its input from the SCAF's audio output when and only when a headphone plug is *not* inserted in the jack.



Close-up of the amplifier board (photo: AA0XI)

It's small enough to fit in many QRP rigs without a lot of fiddling, and any easy solution if you prefer listening to a speaker. The headphone audio provided by a typical QRP rig's LM380 is plenty to drive the amplifier at the *lower* gain setting. And for that matter, most phone jacks support speaker switching— an otherwise unused terminal on the jack makes it possible to have the speaker turned off automatically when the cans are plugged in.

Output from the amplifier is plenty to drive a reasonably sized 8Ω speaker to comfortable listening levels, and introduced noise is minimal..

Assembly:

This is about as simple as a kit can get. There are only 9 components to mount— an IC, a trim pot, 2 resistors, and 5 caps. Make that 4 caps and 8 parts total if you want the lower (26dB) gain setting.

Two decisions need to be made. Capacitor C1 (a 47uF electrolytic) is used across pins 1(+) and 9 of the LM386 to set the higher gain level - leave it out unless you are sure you need all 46dB. And a deliberate solder bridge at an indicated point on the foil side of the board allows the circuit to use chassis ground (meaning only a single connection may be required for input, output, and power instead of the two shown in the schematic). With the supplied board, the solder bridge connects the circuit ground to a trace around one of the mounting holes, so it is grounded to the chassis through the mounting screw.

Once you have wired the amplifier into your project, the trim pot is used to set the input level so that the output is at the desired level. If you have other means of controlling the input (for example, an AF Gain control on your QRP rig) you can just set the pot wide open, or even dispense with it.

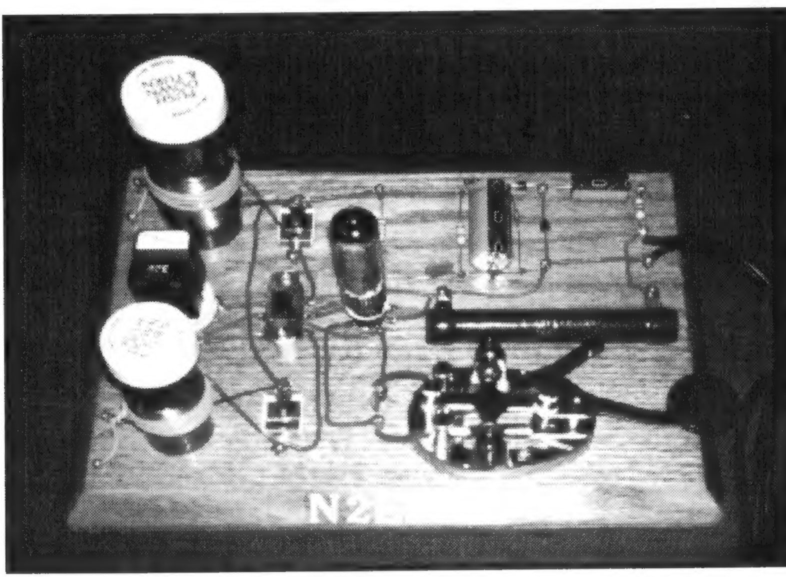
All and all, it is a nice little kit— grab some if you can find them because it is surprising how often they come in handy.

(Continued on page24)

A Two-Band, One Tube Transmitter

Bob Shelton, N2EDF

P.O. Box 185, Ogdensburg, NJ 07439



This project was developed from an article in the Oct., 1994 issue of CQ Magazine. It differs from the transmitter described in that article in that it has both the 80 and 40 meter Bands on the same board, with a slide switch to allow a simultaneous change of both the crystals and the coils, and the two crystals are held in an octal socket. It also includes a polarized line cord to reduce the shock hazard that results if the hot side runs to the key, and a bleeder resistor to reduce the hazard from the charge that remains in the 47MFD. 450 volt electrolytic capacitor after the power is disconnected. (The "B" voltage resulting from the voltage-doubling circuit is about 350 volts.)

The Kit is complete with the tube and all parts (even the brass nails), except for the "breadboard", antenna, key and crystals. A "test" key and crystal are included, consisting of a normally OFF momentary push-button switch, and crystal for 3.7000 mhz. This crystal allows operation, but is not truly designed for use with the kit, which uses an octal socket to hold FT-243 type crystals commonly available at hamfests or from many suppliers. The included crystal was selected to avoid increasing the cost of

the kit, for testing, and because it falls in the Novice portion of the 80 meter band. The thought is that most Hams would want the cost kept down and to pick the frequency of the crystal(s) depending upon the portion of the band intended to be used.

The only tools needed to build the transmitter (other than to make the breadboard) are a hand or small power drill with 1/16" and 1/8" bits, a needle, a hammer, nail-set, screwdriver, needle-nose pliers, a "nipper" or diagonal cutting pliers, knife or razor blade, soldering iron, de-soldering braid, rosin-core solder, and some masking or similar tape. The "breadboard" should be about 10" X 7" X 3/4", and can be of any wood available. The prototype was built on a piece of oak plank flooring cut to size, the edges were beveled and a light stain and polyurethane coat applied before construction for appearance's sake. A suitable scrap can probably be found at a lumber yard, or in a handyman's basement. The physical design is not rigid, and some builders may want to vary the layout to suit their own tastes. Although the design is intended to be built as an open "breadboard", there is no reason it cannot be built in an appropriate enclosure.

In spite of its low cost, this transmitter is not a toy. It is a real transmitter producing 5 to 10 watts of RF power for operation on the 80 and 40 meter Ham bands, and its use is illegal unless a proper amateur license is held by the operator. It is a great Novice project, yet still an interesting one for old timers.

To order the kit, send a check or money order for $39.00 payable to N2EDF to the above address. The Kit will be sent by mail, postage prepaid.

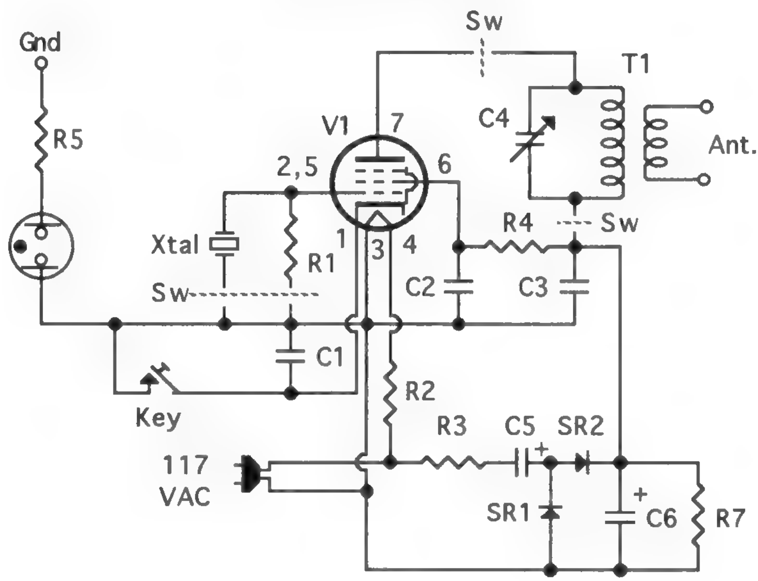
CONSTRUCTION DETAILS

PLEASE READ ALL INSTRUCTIONS BEFORE BEGINNING

The Kit may be built on any 10" x 7" x 3/4" board. Pine is fine, and is easy to work with. A hardwood scrap from a lumber yard or carpenter probably makes a better-looking base. After cutting and finishing (staining and/or a clear or painted finish add a lot to the appearance), decide whether to follow the template provided, or to make modifications. Any modifications should be decided upon in advance, to avoid unnecessary holes in the board. If you are following the template, tape it temporarily to the board and tap nail holes into the screw and nail locations on the board where indicated. Then remove the template and drill 1/16" holes 1/4" deep where nails are indicated. Hammer the free-standing brass nails into the board where indicated so that the heads extend 1/4" to 3/8" above the board. Note that the nails go through the tube socket bracket and trimmer capacitors, which must be prepared for installation as described below.

Wind the coils on the two plastic pill containers. Wind the smaller (40 meter) coil first. Before winding the coils, drill a 1/8" hole in the center of the base of each container and make two small (not more than 1/16") holes in the side of the pill container, 3/4" from the bottom of the container. Although it is possible to drill them, the best and simplest way to make these holes is to hold a needle with pliers, heat it with a match, and burn the holes through. You will have to reheat the needle for each hole. If you have an old pill container, practice on it before making the holes in the supplied

N2EDF ONE-TUBE, 2 BAND TRANSMITTER



Parts List

1-50C5 tube
1-7 pin miniature tube socket
1-.01 μF Cap (C2-marked 103Z)
2-4700 pF (or .05 μF) Cap (C1, C3 marked 472M)
2-2-30 pF Trimmer Caps (C4)
1-47 μF 160 V. Electrolytic Cap (C5)
1-47 μF 450 V. Electrolytic Cap (C6)
3-100 KΩ 1/2 watt resistors (Brn-Blk-Yel-R1, R5)
1-10 Ω 1 watt resistor (Brn-Blk-Blk-R3)
1-10 KΩ 1 watt resistor (Brn-Blk-Org-R4)
1-100 KΩ 1 watt resistor (Brn-Blk-Yel-R7)
1-400 Ω 20 watt sand resistor (R2)
2-1N4004 Diodes (D1, D2)

1-Octal socket
1-Pill container 1 1/2 X 3 inch
1-Pill container 1 3/16 X 2 inch
1-DPDT slide switch
1-NE-2 neon lamp
1-7' solid insulated hook-up wire
1-30' #24 magnet wire
1-2 line polarized line cord
4-1/2" nylon standoffs
1 #8 1" flathead wood screw
4 #6 1" pan head screws
25-3/4" round head brass nails
1-3.700 crystal
1-SPST momentary switch

containers. These holes should be about 1/4" apart and the same distance from the base. Make a second pair of holes 1 inch above these holes on the smaller container, and 1 1/2" above the lower holes on the larger container. To make the holes, tape masking tape around the pill container and mark the location of each hole with an "X". The holes hold the wire in place on the coil. Thread the coil wire through one pair of holes, so that the wire emerges to the outside of the container from each hole, and leave 6 inches of wire extending from the coil. Wind 23 turns around the smaller 40 meter container (46 around the larger). Recount the turns to make sure of the number, and then cut the wire, so as to leave at least 6 inches extending from the coil. After the last turn, insert the wire through the first upper hole and out the second. Keep the windings tight and next to each other. Be careful not to kink or overlap the wire. Masking tape can be used periodically to keep the wire in place temporarily as you continue the windings. When the enameled wire coil is complete, remove any masking tape and make the other coil by winding 5 turns of the insulated hook-up wire around the middle of the first winding on each coil. To hold these turns in place, twist the leads together 3 times on the side of the coil opposite the holes holding the inner coil's leads. Leave 4 inches of wire for soldering to the antenna terminal nails. Using two pan headed screws provided, gently screw each coil in place through the hole previously marked on the breadboard. Be careful not to break the pill container by over-tightening the screw. It should be just tight enough to prevent turning.

The crystal socket needs to be prepared by cutting off every other solder lug, and cleaning the remaining lugs with solder wick. The lugs must be bent out into the spaces in the base of the octal socket for soldering. The socket is held to the board with the large screw.

Cut off the four lower tabs on the tube socket mounting bracket, and bend out the solder connections, so that the solder connections are made to the side rather than under the sockets. Hammer two nails so that the heads catch the edges of the two holes remaining in the tube socket mounting bracket. Place a nylon stand-off on each nail and solder the tube socket to the nails. Keep the orientation of the tube socket as shown in the diagram, and look at the pin numbers on the underside of the tube socket before mounting it. Putting masking tape on the board next to the tube socket and marking the pin numbers on it will avoid mis-wiring. The band switch lugs must be bent out like little feet with a needle nose pliers and the leads soldered to them before screwing it to the breadboard.

Following the schematic and diagram, paying special attention to the polarity of the diodes and electrolytic capacitors, cut, strip and bend the wires and components around the appropriate nails. Clip the ends close and solder the components and stripped ends of the insulated hook-up wire to the appropriate nail heads. Using a "nipper" will make it easier to trim the leads after they have been twisted around the nails. Try to have the solder make a nice round ball around the nail head. Where possible, do not solder a joint until all connections have been made to it. An exception is the power cord, which should be soldered to the nails after the rest of the project is completed, to avoid having the power cord in your way during construction. The side of the power cord attached to the large prong must be soldered to the nail head closest to the 400 ohm sand resistor, in order to keep the hot side of the power cord away from the key. Polarity can be checked at any time by attaching a lead from the neon bulb terminal to a cold water ground (The neon bulb may be installed ahead of or behind the resistor as you wish).

If you do not have a key, solder the momentary switch as a "test" key between the key terminals. Bend out the solder tabs, tin them, and USE VERY LITTLE HEAT ON THEM! It may be left there even when a key is used. The "test" crystal may be installed by carefully bending each solder lead back against itself so that the end of the lead is in the form

of a leaf spring, to hold it in the octal socket. Be careful to insert crystals in the proper socket holes (4 are unused) and be sure that each crystal is in the proper coil circuit.

you have reduced the area to look for problems. Be sure the crystal is making contact with the socket, and that any other non-soldered connections are tight. Recheck everything and

BEFORE PLUGGING IN THE TRANSMITTER, REMEMBER THAT THE VOLTAGE-DOUBLING CIRCUIT GENERATES ABOUT 350 VOLTS! WATCH WHERE YOU PUT YOUR FINGERS AND KEEP BYSTANDERS OUT OF THE WAY!!!!! IT IS BEST TO MAKE A PLEXIGLAS OR WOOD COVER FOR THE HIGH VOLTAGE SECTION!!!!!!!!!

To test the transmitter, tin and solder a 10" piece of insulated wire to the base of a 60 watt household light bulb. Strip 10" off a 20" piece of insulated wire, wrap the bare wire around the threads of the bulb and twist it tight. Strip 1" of insulation from the other ends of the wires, and twist one around each of the antenna terminals. (Alligator clips soldered to the ends make the test bulb more convenient to work with.) First, gently tighten the adjusting screw on the trimmer capacitor. Make sure that the coil (pill container) is empty and the switch is toward the 80 meter coil. Plug in the transmitter, and wait 30 seconds for the tube to warm up. Then with a small tuning tool or plastic handled screwdriver inserted in the trimmer capacitor adjusting screw, key the transmitter (hold down the momentary button) and turn the adjusting screw out. Do not key the transmitter for more than 30 seconds at a time. The bulb should light and become brighter or dimmer as you adjust the screw. Adjust for maximum brightness and you are done. If you have properly constructed the transmitter, the bulb <u>will</u> light! If it does not light, something is wrong. (Be sure the bulb is good before wiring it.) Obtain a 40 meter crystal and adjust that band in the same way.

If the bulb does not light, pull the plug. PUT A SCREWDRIVER OR WIRE ACROSS THE TERMINALS OF THE 47 mfd 450 VOLT CAPACITOR TO BE SURE IT IS DISCHARGED (If the bleeder resistor has been properly placed in the circuit, there will be no spark). If only one band lights the bulb, try again. If you can't find any mistakes, ask someone else to check it out. It's surprising how many times you can look at the same mistake and not see it.

Remember that it is illegal to transmit without a license. IF YOU DON'T HAVE THE LICENSE, DON'T TRANSMIT!

When not in use, the 50C5 tube may be put into the 80 meter coil form and the top screwed on to protect the tube. Extra crystals may be stored in the other coil, but make sure the coil forms are empty before trying to transmit.

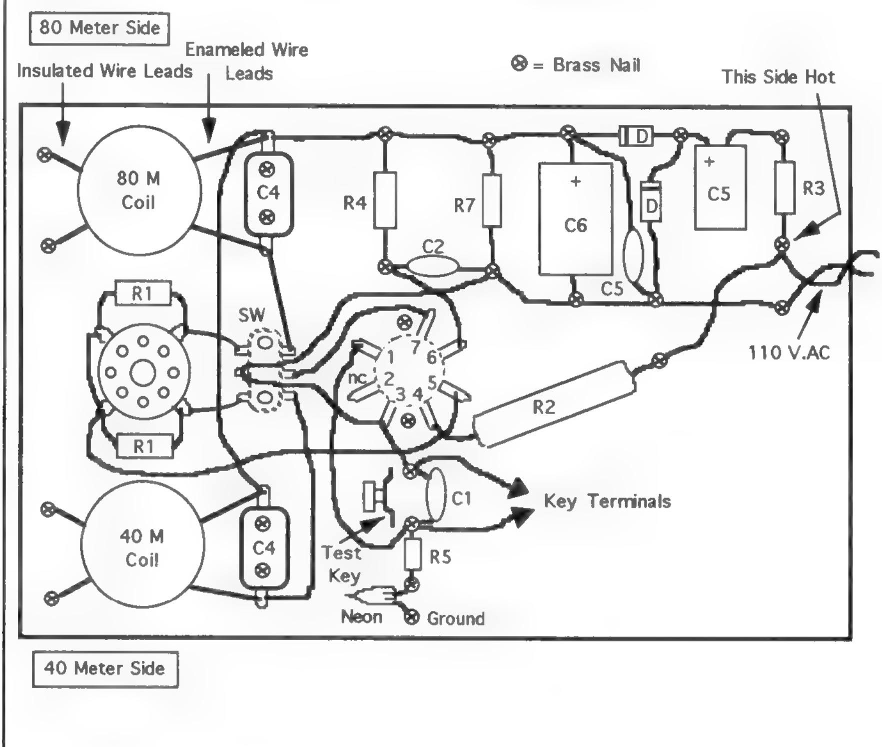
CONSTRUCTION NOTES AND HINTS

Drilling the holes in the "breadboard" can be kept to 1/4" in depth by wrapping a piece of masking tape around the drill 1/4" from the tip and drilling until you reach the masking tape.

The brass nails will fit through the holes in the trimmer caps. Bend their solder tabs out, and then wrap one or two turns of the enameled coil leads around the tabs for soldering. Before soldering the coils to the trimmer caps, be sure to clean the enamel off the ends to be soldered with emery cloth or by scraping with a knife or razor blade. Don't make the coil leads overly loose or tight to the trimmer cap tabs.

The 50C5 tube has been checked before packing the kit, but if it fails within 60 days of our mailing out the Kit, return it to us <u>in the mailing</u>

Parts Placement



container and we'll replace it without charge.

Make a 2 foot long coax (RG-58) pigtail with a PL-259 or BNC connector on one end and arngator clips on the center conductor and braid on the other end, for connecting to the antenna terminals. Of course, the coax may be permanently soldered to the terminal if you prefer, or some more sophisticated termination can be provided on the board, including a T/R switch, but the pigtail works, can be easily replaced, and is simple to use to change bands to the antenna.

I'm sorry I can't take telephone calls, but I'll answer your letter, FAX (201-729-0994), or E-mail: bob @ crystal.palace.net. I'd be interested in your comments, and I'd appreciate a picture of your completed Kit. If you think it was worthwhile, tell your friends. If not, tell me!

HAVE FUN!

Photo, cover, pg. 9: Bob Shelton, N2EDF

Tejas Kits Backpacker I and Backpacker II

Modifications to Increase Transmitter Power Output

Bill Hickox, K5BDZ

9215 Rowan Lane, Houston, TX 77036

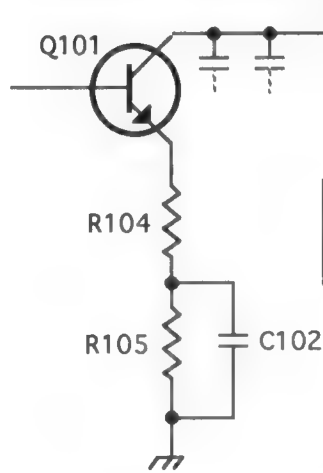


Figure 1

Original *Tejas Kits* Backpacker I and II transmitter output circuits were designed for 2.5 to 3 watts input (1.5 to 2 watts output). Due to repeated requests, I am offering this very simple modification to increase the final amplifier power to the 4 or 5 watts input (3 to 3.5 watts output) level. The modification is very simple. Please note Figure 1 above and make the following changes:

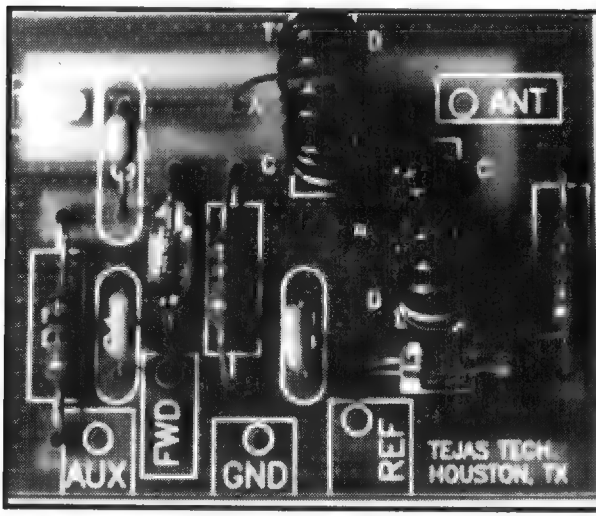
Part Number	Original Value	Modification Value
1. R104	51Ω	10Ω 1/4 watt
2. R105	390Ω	51Ω 1/4 watt
3. C102	.001 μF	.01 μF

(Continued bottom of page 20)

Only a SWR / Wattmeter? Read On, McDuff, Read On!

Bill Hickox, K5BDZ

9215 Rowan Lane, Houston, TX 77036



Pay hundreds of dollars for commercial models of this stuff? $10 in a flea market and a little solder will give you fancier SWR / Watt Meters that do more than the most expensive commercial gear!

In this article, we'll not only show you a few simple SWR type circuits, we'll give you some practical applications, some not found on the commercial market today! The circuit board layouts shown in this article are given as samples of the prototypes used for this article. If anyone, clubs or commercial businesses, wishes to duplicate them, they may do so with the understanding that Bill Hickox / Tejas Kits accepts no responsibility for, nor warrants in any way their use or function. These prototyped designs are just one more kit Tejas Kits planned to bring to market but canceled. However, we freely share our Tejas Kits designs with our fellow hams so we may all benefit. We hope you enjoy these simple designs and applications.

NOTE: Tejas Kits does NOT offer these kits or PC boards for sale!

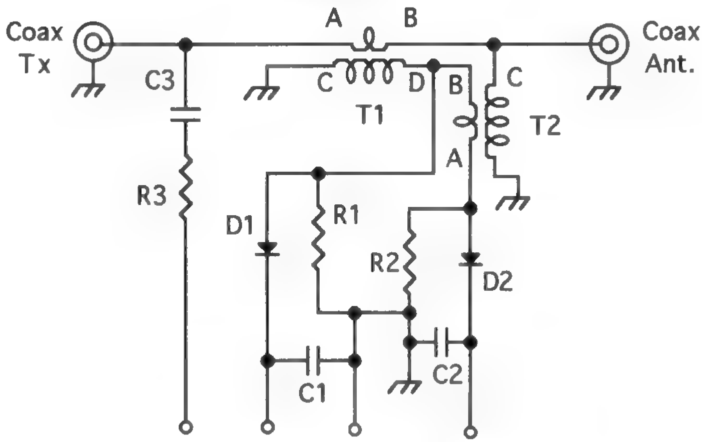
SWR / Watt meter circuitry (Figure 1.): This simple two toroid SWR sensing circuit requires no nulling or adjustments! Therefore it is the most simple of the SWR sensor circuits to design, build and connect. The fixed resistors R1, R2, (and R3) determine the impedance of the circuit(s). They are 51 ohm for 50 ohm circuits, 72 ohm for 72 ohm circuits, etc. Parts values given are for HF (to 30 MHz) and for QRP levels. For 40 to 150 watt power levels, or if T2 gets warm to the touch at your power level, change T1, T2 to T-50-6 (Yellow) toroids

SWR / Power / Monitor Circuit

Bill Hickox / *Tejas Kits*

Prototype Model 94-1A

<u>Figure 1</u>

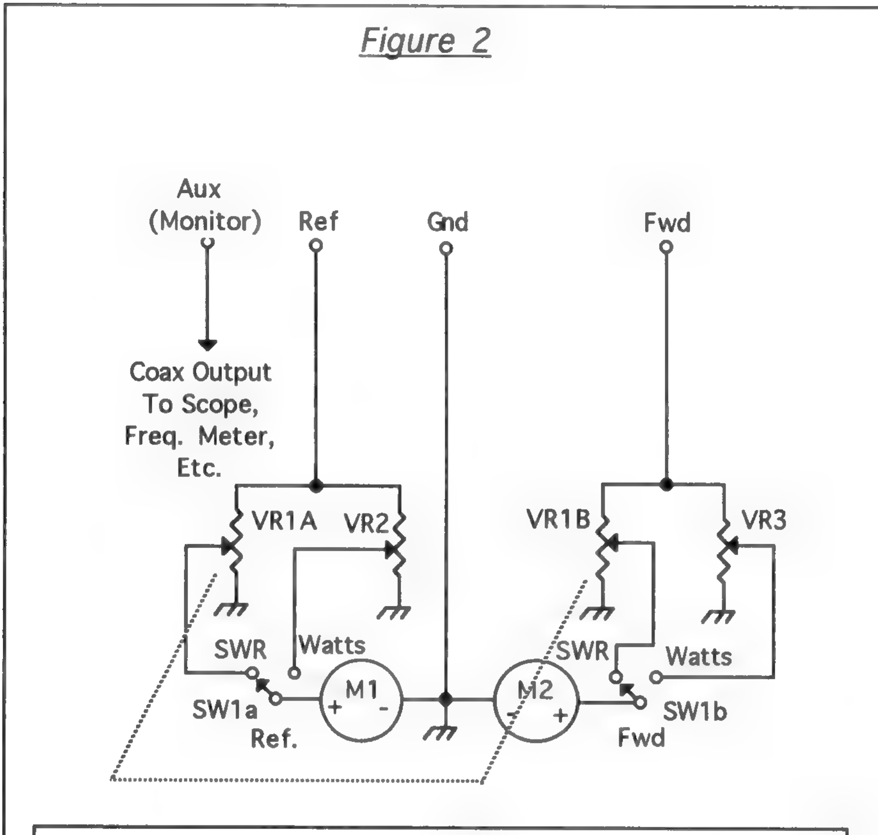


* Fwd and Ref output locations on PC board silkscreen are reversed

Important Note: When installing, for proper operation and most accurate performance, connect grounds to PC board at both Transmitter coax input and Antenna coax output connections! Non-existent, poor or improper grounds at these two points are the mostcommon problem areas.

<u>Parts List</u>

T1, T2	FT37-43, #28 wire, 14 turns Pri., Sec. is 1 turn (pass through wire). Wind both in same direction. Note each toroid connection (A, B, C, D)
C1, C2	.001 μF
C3	5 to 10 pF
D1, D2	1N34A, US270, etc., Germanium Diode
R1, R2, R3	50 Ohm



VR1 = Dual Potentiometer, 10K to 20K per section
VR2, VR3 = 10K to 47K Trimpot
M1, M2 = 50 to 500 microamp meter (they all work about the same in reality)
SW1 = DPDT switch

with 35 turn secondaries and 1 turn primaries. Also increase the voltage ratings of D1 D2 diodes. I suggest US 270, 1N270, or 1N914 or equivalents. Sure, many cheap CB SWR meters use "1N34A" type diodes at levels greater power levels than these, but I prefer margins of safety to protect all my equipment. No parts values or types are given for VHF or for the 1000 watt and greater power levels. Same circuit, just higher voltage ratings and power handling capabilities. For VHF and UHF, different toroid types should be used that will better perform at those frequency levels. Design basics remain the same.

Note the importance of ground connections at the transmitter and antenna connections! These ground connections should not be ignored!

Monitor Circuit (Figure 1.): This is a simple RF (AC) pickoff circuit. The higher the power level, the lower the capacitance value (and higher the voltage level) of C3, and the higher the wattage rating of R3. Why pay from $20 to $100 for a RF monitor pick-up unit

when, for pennies, you can build it into your SWR circuit? Connect this monitor circuit to your bench scope (30 MHz or greater preferred), frequency counter or other monitoring device. This circuit offers negligible loss and is very simple!

Now, I'll bet this simple circuit will soon start appearing in major name manufacturer antenna tuners! I've been using it for years on my homebrew tuners and other RF units. Just remember, you saw it in Hambrew first!

Metering and calibration circuit (Figure 2.) I like two meters so that's the circuit I included. If you like just one meter, have at it. You can design your own single meter circuits or find others in many publications. (Why not try Figure 3?). Rather than a series meter calibration pot used by many, I like the pot shunted to ground design. Lower value (easier to find) pots. I'm a scrounger, and that's important. Switch can be wafer or toggle. It's all self explanatory.

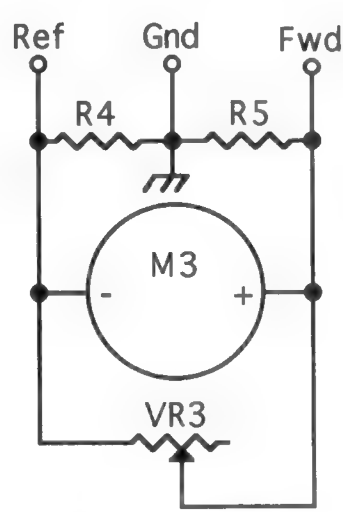
DIFFERENTIAL Circuit (Figure 3.): OK, Folks...this simple circuit should be a future standard for simple SWR circuits in antenna tuners and other equipment!!!!! It's theory of operation is simple:

A. The two voltages (FWD and REF) will "buck," or counteract, each other at the meter, thus varying the meter reading.

B. REF voltage maximum level cannot be

Figure 3

Basic Differential Circuit



R4, R5 = 1K
M3 = 50 - 500 microamp meter
VR3 = 1K or 2K trimpot or panel-mounted pot

greater than FWD voltage maximum level. (That means that reflected power cannot exceed the power output of the transmitter, thus it cannot exceed the maximum FWD power level.)

C. LOW SWR (High FWD voltage and Low REF voltage) produces the highest meter reading. HIGH SWR (Low FWD voltage and High REF voltage) gives lower meter readings since the increased REF voltage is bucking the decreased FWD voltage.

D. The higher the meter reading, the lower the SWR. It's just that simple!

E. VR3 is a panel mount pot that allows meter adjustment for maximum reading for your power level. It also shunts excessive power thus protecting your meter.

This circuit readout is a "no brainer" that allows accurate single meter SWR indication without switching between FWD and REF.

Max smoke = Max output. No Smoke = No output! Simple!

I'll bet this is another simple circuit that will soon start appearing on major name manufacturer antenna tuners, SWR and Watt meters! I've been using it for years on my homebrew tuners and other RF units. Just remember where you saw it first!

Final Comments

Try making your own SWR / Watt meters. Many famous name manufacturers use one set of meters switched between different sensor units (as in Figure 1) for different power levels, different band segments (HF, VHF, or UHF) thus saving the expense of the meters, but charging you extra for each "fancy" multiple duty unit.

You can even add your own homebrew sensors to the big name commercial units you now have, and save hundreds of dollars!

The best source for cheap meters is flea market CB SWR/Power meters. Their meter faces are even calibrated so you don't have to make your own scale!

Finally, if you really want to get fancy (I did) you can use LED or BAR LED readouts rather than meters. NORCAL's club publication had a good simple circuit in their *QRPp*, September 1995 issue. (You don't belong to NORCAL? Shame on you!)

Well, I'm trying to keep the words to a minimum in this and future articles. Not as good as SPRAT or QRPp yet, but I'm trying. Have fun with your new SWR / Watt / DIFFERENTIAL meter. Hope you can improve on all and share it with us.

That reminds me. I think the differential meter is a perfect mod for my Backpacker and HW- 9 since it requires no front panel switching! Thanks for jogging my memory! de *K5BDZ*

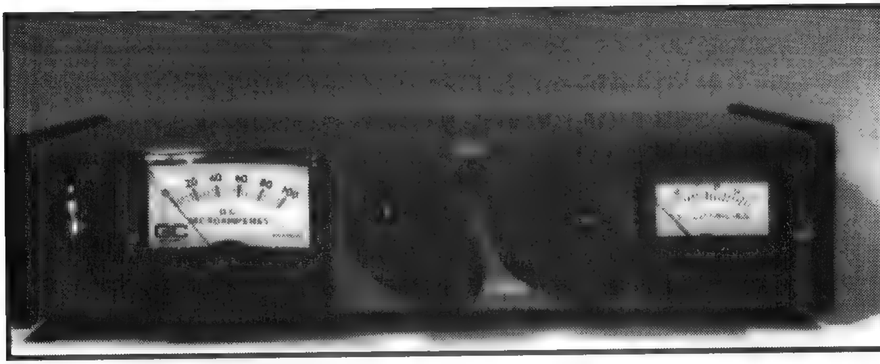
(Continued from page 15)

While transmitting, repeak (for maximum output) the slug in T101. You may need to decrease the Driver (Q101) input power level with R101, as sometimes too much drive from the VFO / HFO will now swamp this modified drive circuit, causing the final amplifier output level to fall. However, the Backpacker's rugged 2SC799 final transistor is rated at 12 watts dissipation, which should easily handle your new increased power level!

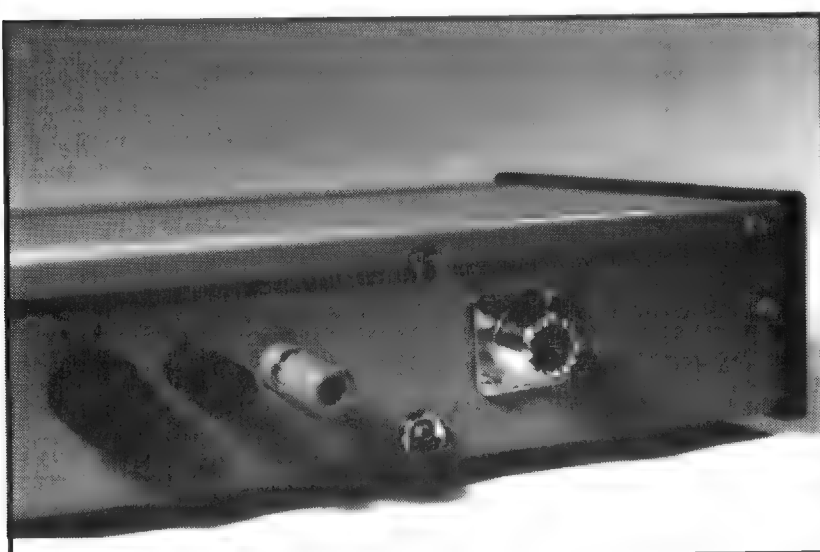
That's all there is to it! The two section Pi Network design remains unchanged!

If keying is too hard at that power level, you may wish to install a .01 to .047 fixed cap in the C119 position on the transmitter PC board.

If you order a new Backpacker II kit from Tejas Kits, this modification is not included. However, if you reference this article, Tejas Kits will include a copy of this modification as well as the above extra parts.

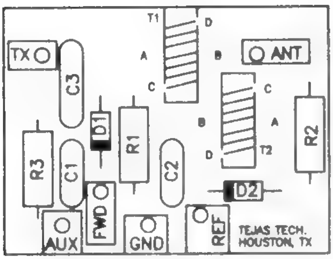


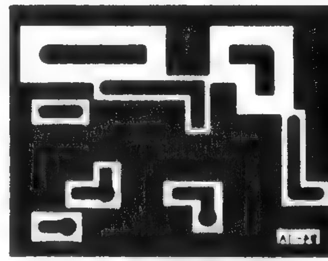
A deluxe SWR Bridge and antenna tuner incorporating the K5BDZ twin-meter circuit plus a prototype Z-Match Tuner from Emtech in Bellevue, Washington (see ad, pg. 40 for address) It indicates instantly the status of power out and SWR at the transmitter. The version of the Z-Match built was that of Charlie Lofgren, W6JJZ in Claremont, California as published in The QRP Quarterly, July, 1995 ("The Z-Match: An Update"). The version above was built for "in-shack" usage. Utilization of smaller meters and a smaller case could allow construction of a unit which would be much moreportable for use in the field. The tuner is for QRP use only, and is not yet available from Emtech as a kit. This tuner/SWR bridge combo is a great performer!
Parts-placement and etching pattern for SWR Bridge are on page 23, this issue.



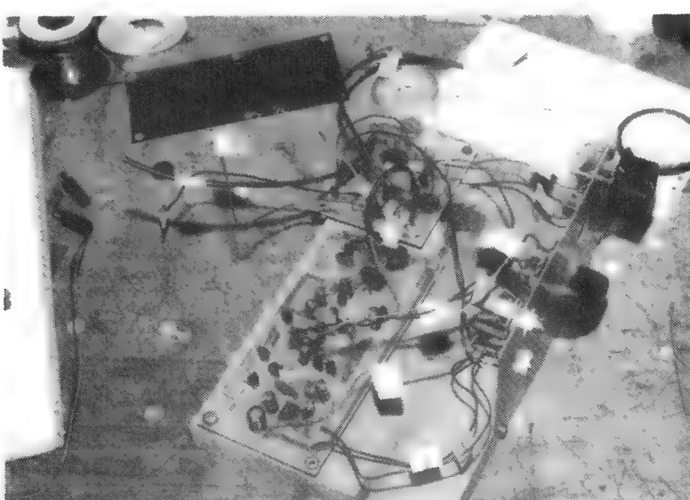
The back of the unit before installation of a second set of antenna lugs. The rotary switch selects high and low impedance secondaries on the tuner's tank coil (hambrew photos).

Parts-Placement and Etching Pattern for K5BDZ SWR Bridge





RIGSHOTS

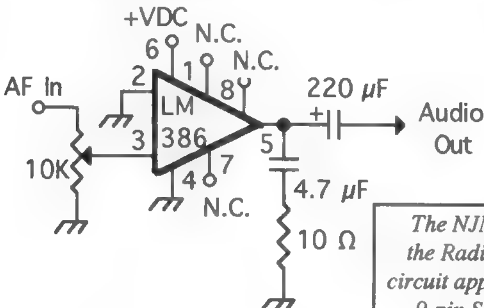


A familiar scene to all who build their own rigs: WØLK, Bob of Mountain View, AR, sent in this shot of an "Ugly Weekender" being measured for a circuit board fit. (photo: WØLK)

(Continued from pg. 8)

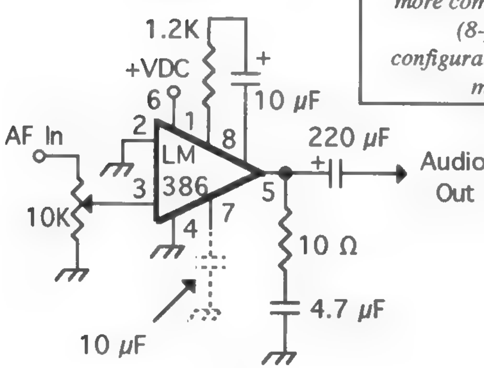
Common Configurations of the LM-386 Audio Amplifier IC

Max. Voltage = 15 VDC

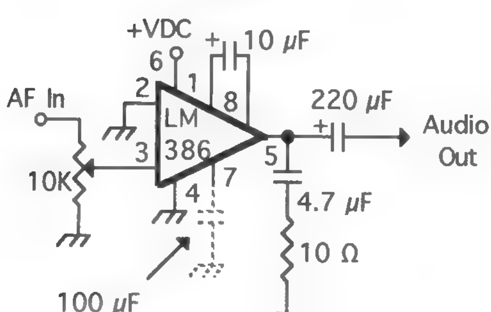


Gain = 20

The NJM386BS chip used in the Radio Shack Amplifier circuit appears to be a special 9-pin SIP which may not be readily available. To use the more common LM386N-8 (8-pin DIP), the configurations shown here may be used.



Gain = 50

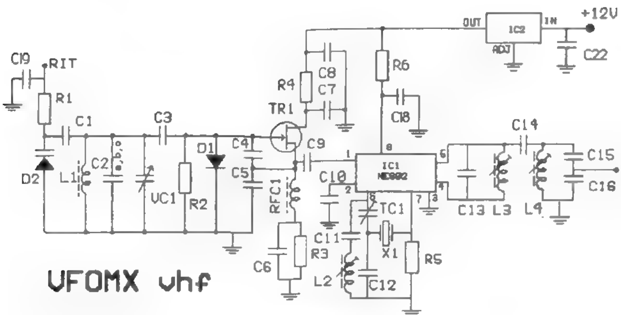


Gain = 200

20/20 Hindsight

Looking Back Into Past Issues • Updates & Elaborations

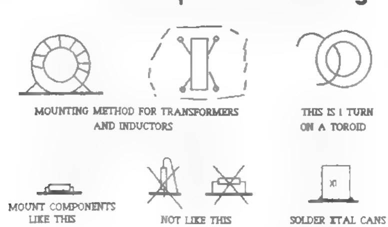
<u>*Winter, 1996*</u>: Hands Kits Review
Additional Schematics



Parts list

R1,2	100K		
R3	180R	C17,20	NOT ALLOCATED
R4,6	100R	TC1	30PF GREEN TRIM
R5	18K	TCA	SEE T & A SECTION TEXT
C1	8P2	TR1	J310
C2	18P	D1	1N4148
C2b,c	SOT	D2	BB105
C3,5,5a,	220P [221J]	IC1	NE602A
C3a,4a	not used	IC2	78L05
C4	180P [181J]	L1	KANK3334[yellow]
C6,7,8 ,10,17,18,19,22	100N	L2	KANK3335
C9	6P8	L3,4	S18 0.45uH
C11	1n	FB1	FX1115
C12	27P	VC1	50PF
C13	39P	RFC 1	100uH[101J]
C14	NOT USED	X1	34.368MHZ
C15	33P		
C16	220P		

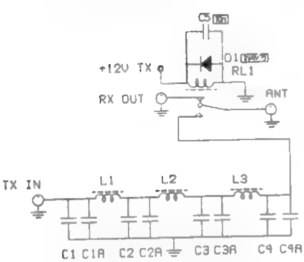
Component Mounting

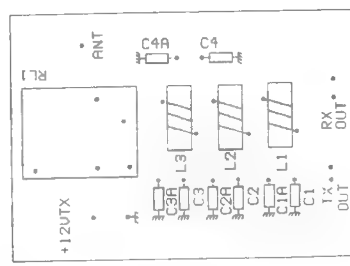


Component and Winding Data

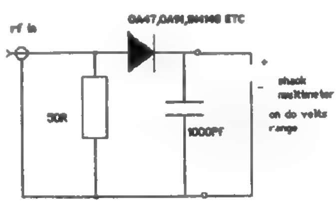
BAND	L1/3	L2	C1/4	C1A/4A	C2/3	C2A/3A	WIRE	CORE
MTRS	*turns*		*pf*		*pf*		*swg*	*type*
160	30	33	820		2200		26	T-50-2
80	21	23	560		1200		24	T-50-2
40	17	18	470		820		24	T-50-2
30	15	17	100	120	470		24	T50-6
20	11	14	100	10	150	150	24	T-50-6
15	11	12	100	10	120	120	22	T-50-6
10	8	10	56		150		22	T-50-6
50	5	5	33	15	68	39	22	no core
	[dia 8mm]	[dia 9mm]						
Cadet	20	23	150	180	820		24	T50-6

Circuit Diagram





PCB Layout



RF Voltmeter

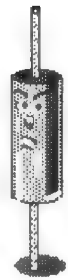
PA3BHK DSB/CW Transceiver

(Winter '96 hambrew)

As we neglected to include the core information on L1, T1, T2, T3, Robert has sent along this information from the Netherlands. Thanks, Robert!

"L1 is wound on a plastic former with a diameter of 5 mm. This is not very critical, so a 1/4" form will probably work just as well. It will probably need some experimenting with the total number of windings, but with a counter or a receiver this should not cause any problems. For the transformers, any RF-ferrite will do. I also made mixers using small ferrite ocres of about 1/4" long and wide with very thin insulated wire. Those "pignoses" as we call them in this country are easier to use and on a relatively low frequency like 3.8 MHz, most ferrite materials will do.

Weird Electronic Science



John Selvia, KB4WHT
ivanjs@dnaco.net
http://www.dnaco.net/~ivanjs/jshp.html

Ed. Note: KB4WHT, John Selvia, has a home page on the world-wide web (above) which spoofs the accepted definitions and norms of electronic components and elements of radio. Peppered with three-letter abbreviations, the definitions, as evidenced below, will no doubt redefine your currently-held notions about the nature of the components and the physics of radio as we have (falsely?) come to know them. Enjoy!

Integrated Circuits Are Your Friends

There is a growing trend in the Popular Press Society (PPS) to label the IC as a compact, electrical device containing millions of resistors, transistors, and other electronic components. I have it on good authority that this perception is totally wrong! The IC is in fact, a large communal gathering of microscopic beings from dimension X who can perform advanced calculations really really fast.

IC stands for Integrated Community. To the keen scientific observer, it is a small plastic thingy (SPT) with metal legs sticking out of it that makes really cool avant garde jewelry and has even been seen on found sculptures.

Through its many microscopic inhabitants (MMI), you can operateyour computer, your compact disc player, your television, and sometimes your car on this wonderful little device (WLD).

While the IC is useful for many different things, don't carry one in your back pocket. The MMIs don't like to be sat on, and they'll send one spear-bearing microscopic inhabitant (SBMI) to each of the ICs legs to poke you in the b**t.

The Buzz on Light-Emitting Diodes

There is a growing trend in the Popular Press Society (PPS) to label the Light Emitting Diode (LED) as a small light emitting device (LEDALSO) which, when forward biased with current, emits a great deal of electromagnetic radiation. I have it on good authority that this perception is totally wrong! The LED is in fact, a transparent housing for small insects which emit light.

LED stands for Light Emitting Diode. It's a small plastic thingy (SPT) with metal legs sticking out of it. The plastic thingy is generally some kind of clear color (here we see red, green, and purple LEDs and some square yellow ones).

An LED actually contains small insects from the backwoods of Eastern Kentucky that are known for giving off different colors of light when aroused. It just so happens that electrical current in an electronic device provides them with artifical stimulation, and therefore, they glow.

(Continued on page 35)

Deep Six

Fred Bonavita, W5QJM

PO Box 2764
San Antonio, Texas 78299

Eye on 50 MHz

CONTEST TIME: Six Meter International Radio Klub's annual contest once again falls between the ARRL VHF QSO Party (June 8-10) and Field Day (June 22-23), and expectations are that the turnout will exceed last year's record response. (See QST for rules of those contests.)

The 48-hour SMIRK event begins at 0000Z June 15 and ends at 2400Z June 16. It's 6 Meters only, CW and/or voice modes. Among the 48 contiguous states, voice contacts are restricted to 50.125 MHz and above and CW below 50.100 MHz or above 50.125 MHz. Only DX contacts are permitted between 50.100 and 50.125 MHz.

Exchange is callsign, SMIRK number and grid square. No crossband or partial contacts allowed. Scoring: 2 points for each SMIRK member and 1 for non-member. Final score is total points times grid squares worked.

Entries must be postmarked no later than July 15 to Pat Rose, W5OZI, PO Box 393, Junction, Texas 76849-0393. Send Pat a legal-size, stamped envelope for a log form. Pat also is the source of information on SMIRK.

6 Meter Converter: Master designer-builder David Anthony, W5NOE, was kind enough to share the 6 Meter converter he uses. (For a look at Dave's station and the superb gear he has designed and built, see **hambrew** for September 1994.)

This converter plugs in to Dave's station. The local oscillator tuning provides 50.0 - 50.5 MHz coverage with a receiver tuning 3.5 - 4.0 MHz.

"This is all based on the original 'CER-verter' circuits by Wes Hayward, W7ZOI,' Dave writes. "I have rescaled the L/C elements of the post-mixer diplexer to match my IF (receiver) of 3.5-4.0 MHz.

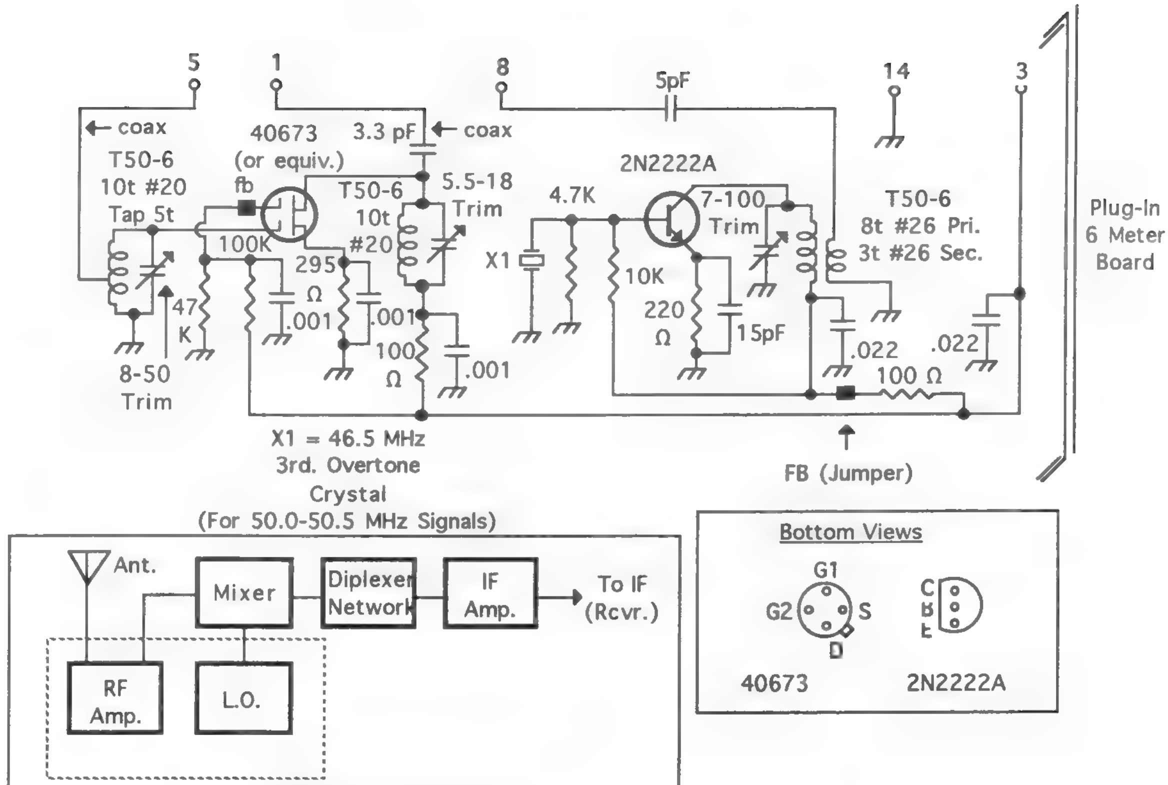
"The MosFet IF output was broadband, so I did not alter it. An alternative to the 40673 is the NTE222, and the neat little TFM-2P would sub for the UM1-H (diode ring mixer),' he continued. (The TFM-2P is by Mini-Circuits and is a smaller version of the popular SBL-l mixer.)

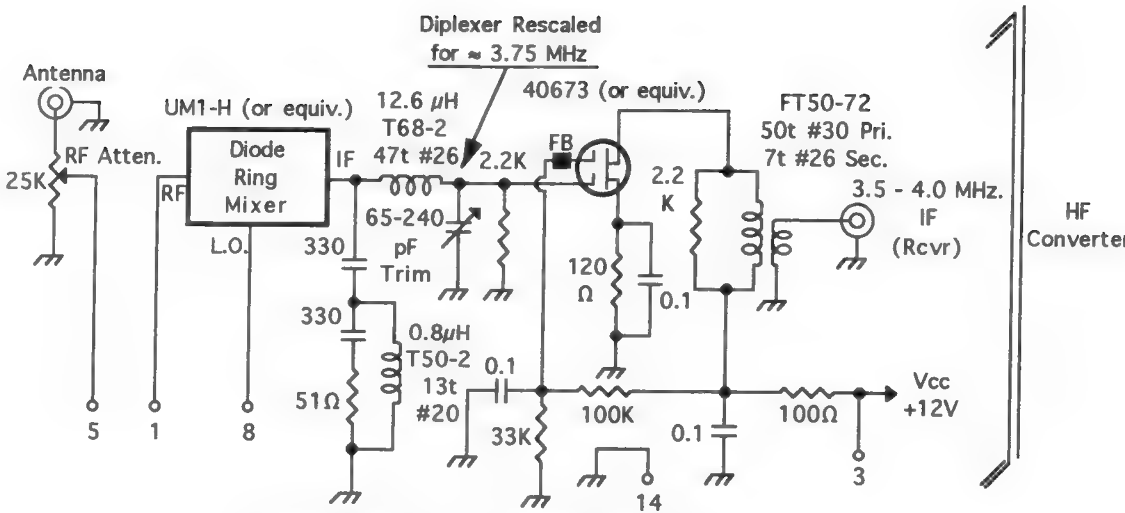
"Doubly balanced diode ring mixers need lots of 'beef' from the crystal oscillator. This one provides 5mW or more. With the 5pF output cap and a 51 ohm resistive load temporarily connected to pin 8, 0.5v RMS is measured with a VTVM," Dave said.

He also urges would-be builders not to be put off by the odd 295 ohm resistor and 3.3pF caps, since they were probably what was available when he built this converter.

Meanwhile, Dave is hard at work on another 6 Meter converter. This will be a bare-bones/ low-cost unit using a MosFet and an NE602N. Stay tuned!

And if you have any 6 Meter circuits and/or operating news you would care to share, pass them along to me or to the editor, and we'll get them into print. Thanks!


5
1
8
14
3
5pF
coax
coax
T50-6
10t #20
Tap 5t
40673
(or equiv.)
fb
3.3 pF
T50-6
10t
#20
5.5-18
Trim
2N2222A
4.7K
7-100
Trim
T50-6
8t #26 Pri.
3t #26 Sec.
Plug-In
6 Meter
Board
100K
295
Ω
.001
47
K
8-50
Trim
.001
100
Ω
.001
X1
10K
220
Ω
15pF
.022
.022
100 Ω
FB (Jumper)
X1 = 46.5 MHz
3rd. Overtone
Crystal
(For 50.0-50.5 MHz Signals)
Ant.
Mixer
Diplexer
Network
IF
Amp.
To IF
(Rcvr.)
RF
Amp.
L.O.
Bottom Views
G1
G2
S
D
C
B
E
40673
2N2222A



(Modified Version of "Cer-Verter") Ref: QST 6/76, Pg. 33; QST 8/76, Pg. 39; QRP Classics, Pg.40, First. Ed. Solid State Design for Radio Amateurs, First Ed., Pg. 139 (Beware of errors, typos, omissions, and ignored 'feedback' items in the above!!)

A Five Buck Final for 6

Jeff Duntemann, KG7JF

6840 E. Lowden Drive, Cave Creek AZ 85331 / jeffd@coriolis.com

and

Kent Ogletree, KD6NHP

Here's a handy and nearly indestructable 1W final or driver for 6 meters, which can be done on the cheap and in a hurry. The basic design we adapted from the 6M QKP CW transmitter in *Solid State Design* by Wes Hayward and Doug DeMaw. We removed the crystal oscillator and keying circuit, and tinkered the bias a little bit.

The 2N3904 buffer runs Class A and puts out about 50mW. It has extremely high gain and you can drive it with very little signal. We also found that of all the transistors we tried, the 2N3904 was the least likely to go into VHF oscillation. It's a rugged little part, and almost free on the market.

I have no idea what sort of ferrite beads I used. I had some rolling around in a drawer, and put two on the wire. Use what you can find. The circuit works without them, but it will oscillate and "kick" at certain (non-optimal) settings of the pi net.

Hayward & DeMaw used a 2N3925 as their final, but that's a part I've never seen on the market and haven't used. The 2N3553 is a bear of a transistor for a TO-39, and it can be pushed to over 2 watts if you run it with a 28V supply. (I haven't tried that yet on this circuit—but I'd be interested to hear how well it works.) Best of all, B.G. Micro has house-numbered 2N3553s for 99c each!

The 2N3553 must be heat sunk. I had a number of vaned "Mexican hat" heat sinks measuring
1 3/8" in diameter, and I designed the board as wide as the heat sink. Most such heat sinks are smaller. If you use a sink like I did, you'll have to position it so that L3 lies between two of the vanes. Keep in mind that the TO-39 case is connected to the collector and us thus hot atRF.

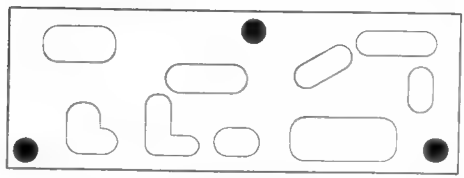
I made the board on a piece of 2-sided PC stock measuring 3 3/4" X 1 3/8". I rasped out the pattern using a Dremel tool and a pointed burr. A ball burr is easier to control but cuts a wider swath. Components are mounted on the other side of the board, not the pattern side! You'll have to drill component holes first, and then remove a little copper around the top sides of those holes that carry leads through the board—or at least those that aren't at ground. I use a 9/32" drill bit and bring it down over the holes in (luestion just hard enough to remove the copper. Don't go through the board! Those holes carrying grounded leads should be left alone, and soldered on both sides, to provide a number of "gwunded tbrough" holes to link the ground planes on the two sides of the board.

To align the board, hook it to a power meter capable of resolving a watt or less (I recommend the one from Oak Hills) with a dummy load on the output side, and feed it 2-5 mW at 6M. Peak the driver trimcap for maximum output, then the pi net on the output. Check it on a scope to make sure it's not oscillating. The only times we saw the board "take off' was with a 2N2222A or 2N706 in the driver slot. Total current draw at 1W is about 180 ma or a little more.

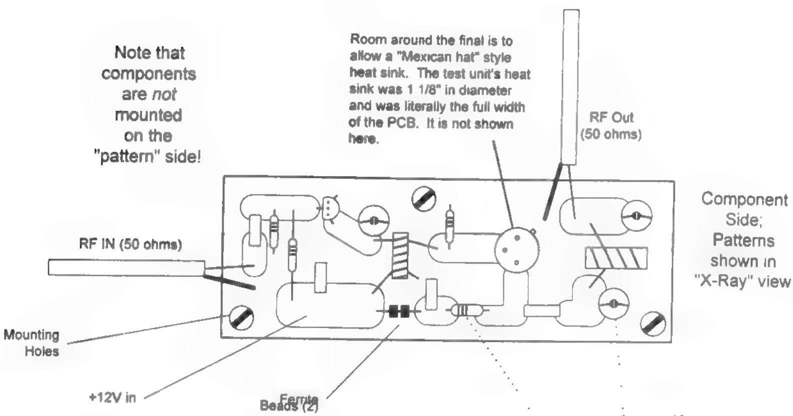
You should put a 6M low-pass filter on the output if you use the board as a final amp. The one shown is from the 6M transverter project

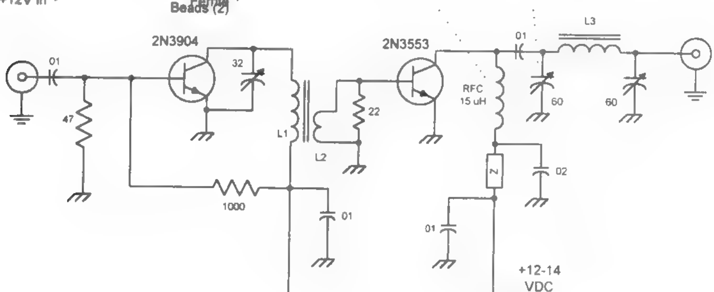
1-Watt 2N3553 Power Amp for 6 Meters

"Shapes" on board are "islands" etched or cut with a Dremel tool.



Pattern Side (Full Size)



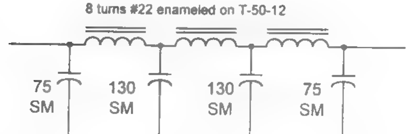


NOTES

L1: 9 turns #28 enameled on T-37-6
L2: 2 turns #28 enameled on L1 core
L3: 6 turns #22 enameled on T-50-6
"Z" indicates ferrite bead

At 12VDC:
Current draw is approximately 180 ma
Measured output .8-1.0 watts at 52.5 Mhz

All three coils in the filter:
8 turns #22 enameled on T-50-12



"Four Days in May®"
Bob Gobrick VO1DRB/ WA6ERB

Greetings from the "Four Days in May®" QRP Symposium Committee. We hope you will be able to attend the first annual QRP Amateur Radio Club, International (QRP-ARCI) sponsored "Four Days in May®" QRP Symposium on Thursday May 16,1996 at the Days Inn Dayton South hotel (Dayton, Ohio). We are now convinced more than ever that this first-ever QRP ARCI Symposium will be unsurpassed in the quality of the technical talks and unsurpassed in the excitement of a very special "qrp world announcement".

QRP SYMPOSIUM PRESENTERS

The quality of papers submitted to Bruce Muscolino W6TOY/3, our FDIM Technical Paper Chairperson, have been outstanding. As of January, twelve world-wide presenters have made commitments to present papers. The paper titles and presenters will be released in a forthcoming announcement, but it's fair to say that the technical topics submitted so far cover many aspects of qrp design, antennas, and operating methods. As a quick preview we've had a chance to review a paper being presented by L.B. Cebic, W4RNL, on Small Loaded Yagis and the quality of the paper exceeds the material that L.B. has published in the "Communications Quarterly - The Journal Of Communications Technology". This paper presentation alone should not be missed. As previously announced all "Four Days in May®" QRP Symposium attendees will receive a copy of the official QRP Symposium Proceedings as part of their registration fee.

QRP SYMPOSIUM EXCLUSIVE

In our December 1995 QRP Symposium posting it was announced that the The Four Days in May (c) Committee had secured the exclusive rights for the world premier of a new and exciting QRP Technical Book. The official announcement of the book, the title and the sponsoring QRP Club will be announced in a forthcoming posting. We have had a chance to preview only a small portion (40 pages) of this new book and we predict that this book will be in EVERY QRPer's library. The portion of the book that we reviewed was packed with reams of qrp design data on components, circuits and techniques - more qrp design information than has ever been assembled in any publication to date. In conversations with the author, his goal was to produce a qrp design book that would bring credibility to the great advances made by the qrp radio designers of today. No more will QRPers be associated with cute little sardine can radios.. and from our first preview there is no doubt in our minds that this goal will be achieved.

As announced in the Dec95 posting we have booked a special QRP Symposium presentation by the author and the sponsoring QRP

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in the ARRL *Handbook*, and works quite well.

Several of these boards have been made, and all worked perfectly, assuming the 2N3904 is the driver. None have died, for all the abuse I've handed them. I'm not making up boards or kits for this item, though I encourage others to do so.

I'm currently tinkering up a simple MCW exciter for the board. Why MCW? Well, if you can rope a few local scanner owners into getting their Tech, they can use their scanners as receivers for "around the neighborhood" MCW contacts, and get their code speed up to General levels while having a good time in the process.

You can get the transistors and the driver trimcap from B.G. Micro. Get their catalog too!

B. G. Micro
PO Box 280298
Dallas TX 75228
1-800-276-2206
bgmicro@ix.netcom.com

SWR Chart

The SWR scale and what it means in actual power or percentage of power reflected

SWR (Standing Wave Ratio)	% Reflected Power	Watts Reflected (Based On 100 Watts Output)
1.0 : 1	Negligible	Negligible
1.2 : 1	1%	1
1.5 : 1	4%	4
2.0 : 1	12%	12
2.5 : 1	18.5%	18.5
3.0 : 1	25%	25
6.0 : 1	51%	51

Chart Courtesy of Bill Hickox, K5BDZ

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<u>*Resistance is Futile*</u>

There is a growing trend in the Popular Press Society (PPS) to label the resistor as a current-resistive material used to control the flow of electrons. I have it on good authority that this perception is totally wrong! The resistor is in fact, a member of a group of freedom fighters from dimension BR549; it just so happens they are really good at controlling current in a circuit.

To the casual observer, the resistor is quite pretty, with its little color coded bands and somewhat feminine shape (SFS).

In actuality, the resistor is a being from another dimension with keen knowledge of killing methods who is bred for the sole purpose of resisting a violent race of overthrowers that took over the resistor's world millenia ago.

The color codes, which we have mistakenly associated with a numerical method of describing a resistive value (NMDRV), areactually maps pointing to the overthrowers main weapons depots and information on how to destroy the overthrowers.

Resistors can fight much better when connected in series with each other.

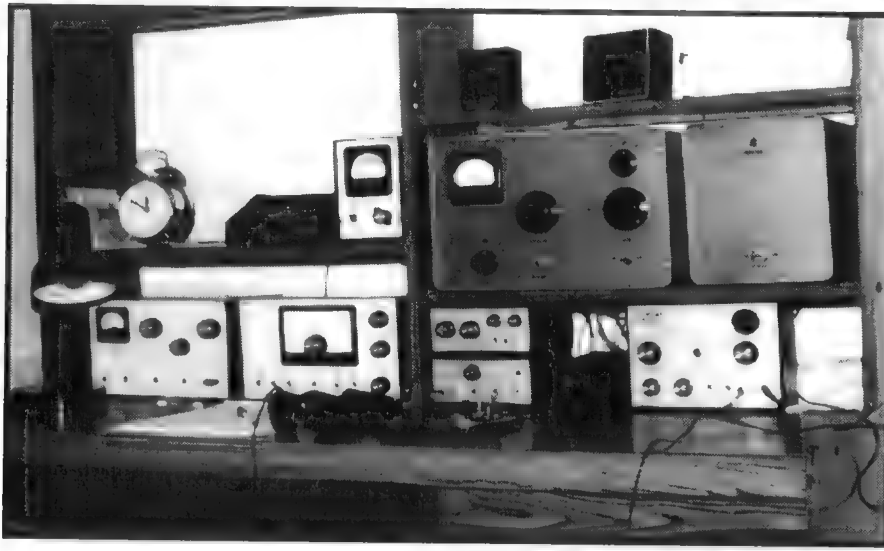
<u>*I Have Reached My Capacitance*</u>

There is a growing trend in the Popular Press Society (PPS) to label the capacitor as an electronic device which temporarily stores electrons by using 2 conductors separated by what is known as a dielectric.

This one is true.

John solicits contributions to his web page. If you have made any important discoveries related (or not related) to the startling information revealed in this article, John would like to hear from you in between his battles with resistors from other dimensions!

RIGSHOTS



Here are two shots from the shack of Reg Tremblay, VE3GQD of Unionville, Ontario. The top photo shows an all-homebrewed station which should gladden the hearts of homebrewers everywhere. What a beaut! The bottom photo shows a 20 meter 4 watt VFO-controlled CW transceiver. The transmitter section is from CQ Magazine (May, 1980), and the receiver is the K6LMN simple superhet (hambrew, Autumn, 1994). (Photos: VE3GQD)

My List of Mail Order Electronics Companies

John Woods, WB7EEL

jfw@jfwhome.funhouse.com

Here is my list of companies which will sell electronic components in small quantities. Many of these places I have bought from, several I haven't. Being a ham radio operator, I am most interested in RF components, and in particular, air variable capacitors, which tend to be scarce (and tend to be used or surplus even if I've otherwise labelled the seller as "NEW").

Categories are: • NEW COMPONENTS: Distributors and sellers of new components, or "new and some used" in a couple of cases.• SURPLUS ELECTRONICS: Usually overstocks, occasionally used equipment. Ideal for stocking the junkbox, usually have dependable stock lines of resistors, capacitors, and some semiconductors, but won't have those LCD modules forever... An invaluable resource, don't shy away from them.• SPECIALTY COMPONENTS: In particular, crystals and toroidal cores. • KITS: Ham radio kits, random electronic kits, whatever they have. • LITTLE GUYS: Separated out because of some twisted sentimentality, I suppose. Intended to honor one or two ham spare-bedroom operations. Note that sending $1 along with catalog requests is a big help for these folks. • PUBLICATIONS: A small selection of publications dealing with electronics, especially RF electronics. • QRP CLUB PUBLICATIONS: Clubs for low-power amateur radio enthusiasts; frequently have publications with quite a bit of technical content (which is why I'm a member of QRP clubs headquartered thousands of miles from where I live. Note, this is generally practical technical content (how to build it) rather than theoretical technical content (why it works), but definitely more than Contester's Quarterly.

Note on shipping costs: I don't always update these frequently enough, and they're generally for continental US unless otherwise mentioned.

SURPLUS ELECTRONICS:

<u>All Electronics Corp.</u>
P. O. Box 567Van Nuys CA 91408-0567
1-800-826-5432, 1-818-904-0524, 1-818-781-2653 (FAX)
http://www.allcorp.com/allcorp/
NO minimum, $5.00 S&H. New and surplus electronics. Check out their web page!

<u>Alltronics</u>
2300 Zanker Road, San Jose CA 95131
1-408-943-9773, 1-408-943-9776 FAX
Surplus electronics. $12 minimum, shipping per UPS.

<u>American Science and Surplus (formerly JerryCo)</u>
3605 Howard StreetSkokie IL 60076
1-708-982-0870, 1-800-934-0722 FAX
Surplus. *The* surplus place. Lots and lots of surplus. WWII gun cameras, velcro, laser disk chassis, 6 volt VW wipers motors, LEDs, rubber brains, you name it, they've had it. Catalogs are a really good time.$12.50 minimum order (which includes the $4 shipping charge).

<u>BCD Electro</u> (Out of the mail order business!)
P. O. Box 450207, Garland TX 75045-0207
1-214-343-1770
According to Barrie Britton (24 Feb 94), BCD has gone out of the mail order business.

Fair Radio Sales
P. O. Box 1105
1016 E Eureka St
Lima OH 45802
1-419-227-6573
Surplus electronics. Heavy on parts for old Collins gear.

Hosfelt Electronics
2700 Sunset Blvd., Steubenville OH 43952
1-800-524-6464, 1-614-264-5414 (FAX)
No minimum, $3.75 S&H. Surplus electronics.

HSC Electronic Supply (Halted Specialties Co.)
3500 Ryder Street, Santa Clara, CA 95051
1-800-4-HALTED Orders only, 1-408-732-1573 (inside California and outside US)
Surplus (new) electronics; new and used test equipment. Minimum order $10 ($2 handling charge under $20), plus UPS shipping cost. Has three stores, of which 3500 Ryder Street is one.

Marlin P. Jones & Assoc.
P.O. Box 12685, Lake Park FL 33403-0685
1-407-848-8236, 1-407-844-8764 (FAX), 1-800-4-FAX-YES (FAX)
Minimum order $15, shipping per UPS. Surplus electronics.

R&D Electronics
5363 Broadway Ave, Cleveland OH 44127
orders: 1-800-642-1123 (tues - fri 9am-4pm sat. 9am-3pm EST), info: 1-216-441-8500, fax: 1-216-441-8503
$10 minimum. Surplus electronics. "Also known to stock many components, but this is not discussed in the catalog. Local store, a cleveland institution, is called Electronic Surplus, Inc., and has been there since '48. Third generation now runs it."-WB8FOZ 7/13/94: Dave Lesher (WB8FOZ) updates their hours as M,W,F 0900-1900; T,R 0900-1600; S 0900-1500; but wasn't sure if that was the store hours or the order line hours (but likely both).

Surplus Sales of Nebraska
1502 Jones Street, Omaha, Nebraska 68102
1-402-346-4750, 1-402-346-2939 (FAX)
New and surplus radio electronics. Wide selection: air variables. Catalog $3 (free with order, refundable with $25 catalog purchase).

Tucker Surplus Store
1717 Reserve St., Garland TX 75042
1-800-527-4642 extension 135
Surplus electronic gear; oscilloscopes and signal generators from the days when dinosaurs with vacuum tubes roamed the earth (some solid state gear, but all well used). Prices seem relatively high, and you'll be shocked to learnhow much it costs to ship a 75 pound oscilloscope by motor freight...[Steve Brown, N8HFI: In defense of Tucker, they have a broad selection, repair facilities, and they certify the used equipment to meet the original specification and warranty it for 90 days. Not every source does this.

Davilyn Corp.
13406 Saticoy St., North Hollywood, CA 91605-3475
1-800-235-6222 (Ex. CA), 1-818-787-3334 (CA), 1-818-787-4732 (FAX)
Surplus electronic gear."...has much better prices [than Tucker], but sells used equipment as-is". -N8HFI

SPECIALTY COMPONENTS:

JAN Crystals
2341 Crystal Drive
P.O. Box 06017, Fort Myers, FL 33906-6017
1-800-JAN-XTAL (Monday through Thursday), 1-813-936-3750 (FAX)
1-813-936-2397 (plant)
They make crystals. Minimum order is $10, which might be one crystal, or might be two.

Crystek Corporation
2351/2371 Crystal Drive
P.O. Box 06135
Fort Myers FL 33906-6135
1-800-237-3061 (M-F) (US and Canada but not Alaska and Hawaii)

1-813-936-2109, 1-813-939-4226 (FAX)
They make crystals too. They were the cheapest last time I ordered, butI don't have an up-to-date price list. It took about 4 weeks, and theyhad said it would take 6.

ICM (International Crystal Manufacturing Co., Inc.)
701 W. Sheridan
PO Box 26330
Oklahoma City, OK 73126-0330
1-800-426-9825
More crystals. They were more expensive, but they have lots of pre-made crystals for various rigs, so they would probably be faster.

Amidon Associates
3122 Alpine Way
Santa Ana, Calif. 92074
1-714-850-4660
Toroid cores and related things. Very fast service. Now takes MC/Visa andphone orders. I *think* this is their current address, they seem to move a lot.

Palomar Engineers
Box 462222
Escondido CA 92046
1-619-747-3343
1-619-747-3346 (FAX)
Toroid cores and shielding beads, baluns, frequency meters, etc.Call for free catalog.

RF PARTS
435 South Pacific Street
San Marcos CA 92069
1-800-RF-PARTS (Orders only)
1-619-744-0700 (main order line & delivery info)
1-619-744-0750 (customer service, warranty, tech & applications, 10AM-4PM)
1-619-744-1943 (FAX)
Tubes and transistors. $2 handling below $20 for US orders; $5.50 minimum handling for Canada orders; they take foreign orders (but no handling info was given in the *QST* ad).

K2AW's Silicon Alley
175 Friends Lane
Westbury NY 11590
1-516-334-7024
Free catalog, $10 minimum order. Semiconductors, in particular high-voltage diodes.

Small Parts, Inc.
[New address and phone, 23 Dec 91]
13980 NW 58th Court
P.O. Box 4650
Miami Lakes, FL 33014-0650
1-305-557-8222 Order department
1-305-557-7955 Customer Service (ask for Mirta)
1-305-558-1255 Catalog (ask for Elizabeth)
1-305-557-8004 Custom-made Parts (ask for Ziggy)
1-305-557-8005 Non-standard Sizes of catalog parts (ask for Eric)
1-800-423-9009 Toll free FAX line$12 minimum.
Mechanical parts, metal stock, Teflon(R) sheets, tools,wire-size drill bits (as in #61 size for PC board holes).

(Continued from page 34)
club publisher. ALL "Four Days in May®" QRP Symposium attendees will receive an autographed copy of the new book as part of their registration fee. This offering is an exclusive to QRP Symposium attendees.

Technical seminars will be the largest part of "Four Days in May®" - the first annual QRP-ARCI QRP Seminar. The seminars will consist of technical papers, written by QRPers for QRPers.

LUNCHEON SPEAKER

Paulette Quick N9OHU, our FDIM Registration Chairperson has lined up a sumptuous and scrumptious luncheon for ALL QRP Symposium attendees. This will be a sit down affair complete with a surprise luncheon guest QRP speaker. The speaker announcement will be forthcoming. Once again, the luncheon is an exclusive for the FDIM attendees and the cost is included in the registration fee.

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DESIGN BASICS SERIES

Thoughts On Theory

Transistor Biasing - Part III

James G. Lee, W6VAT

In the previous two installments I talked about both the *poorest* and the *best* methods of biasing a transistor amplifier. These set the **DC operating conditions,** and assume any applied **AC signals** are 'small signals" - that is, they don't exceed 10% of the applied DC voltages. But sooner or later, these "small signals" will be amplified up to the point where they make large changes in the currents and voltages in any following stages. This is called '**large signal operation**" and you get into the area of "load lines" and transistor "saturation current" as a means of designing an amplifier.

In the days of vacuum tubes, manufacturing processes were very repeatable, and a set of curves called "characteristic curves" were available for every tube. Tube characteristics were so constant you need not worry if you replaced one tube with another one of the same type. But transistors are not blessed with this repeatability, even though very early on there were published characteristics for many transistors.

FIGURE 1 shows a typical set of transistor characteristic curves. It displays how the collector current, I_C, varies with the collector voltage, V_{CE} (or V_{cc}) for any given base current, I_B. Note the two regions of the curves - here separated by a dotted line - are called the **"ohmic region"** and the **"saturation region"**. To the left in the ohmic region only small changes in V_{cc} result in large changes in I_C for a given base current. Although they are not as linear as Ohm's law would be, they still respond as if they are resistive in nature.

To the right in the saturation region. there is very little change in collector current for large changes in the collector voltage for any given base current. A transistor is considered saturated when it can draw no more current for a given set of operating conditions. Stated another way, the saturation current for a transistor is limited as follows:

$I_{Csat} = V_{CC} + (R_L + R_E)$
where I_{Csat} = collector saturation current
R_L = load resistor
R_E = emitter resistor.

In this instance the transistor appears as a short, or very low resistance, to the series combination of R_L and R_E.

THE DC LOAD LINE

At saturation. there is essentially no voltage across the collector and emitter, i.e.. $V_{CE} = 0$ volts. If you calculate the saturation current, you have one end of a load line. This point is marked B in FIGURE 2. If the transistor is fully turned off so that it no longer conducts current, there is no current through R_L and the voltage at the collector goes to the full supply voltage V_{cc}. This is point A in FIGURE 2 and is the other end of the DC load line. Drawing a straight line between these two points shows the locus of all possible DC operating voltages and currents.

In the base bias amplifier of FIGURE 3, it is normal to set the operating point so that V is 1/2 the supply voltage, V_{cc}, or 6 volts. This point on the load line corresponds to a collector current of 6 mA - see FIGURE 2. This point is marked "Q" on the load line, with Q standing for the *"quiescent"*, or "no-signal", point. This point also falls on the 60 uA base current line

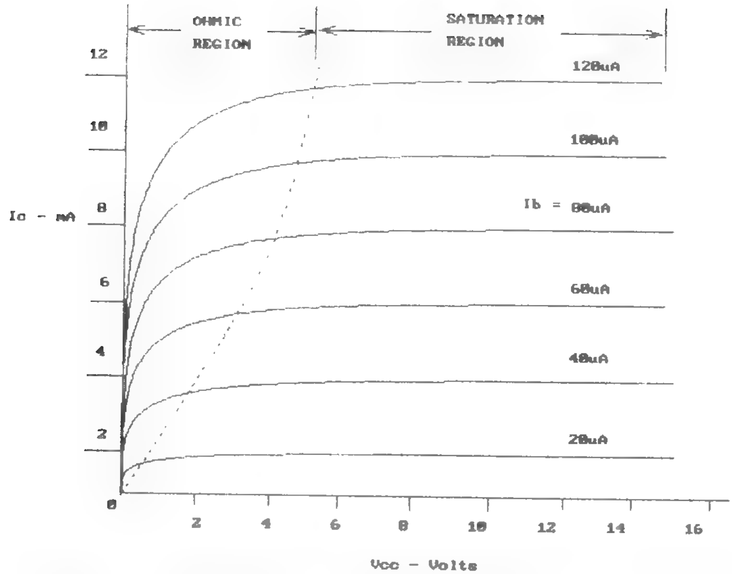

FIGURE 1: Transistor Characteristic Curves

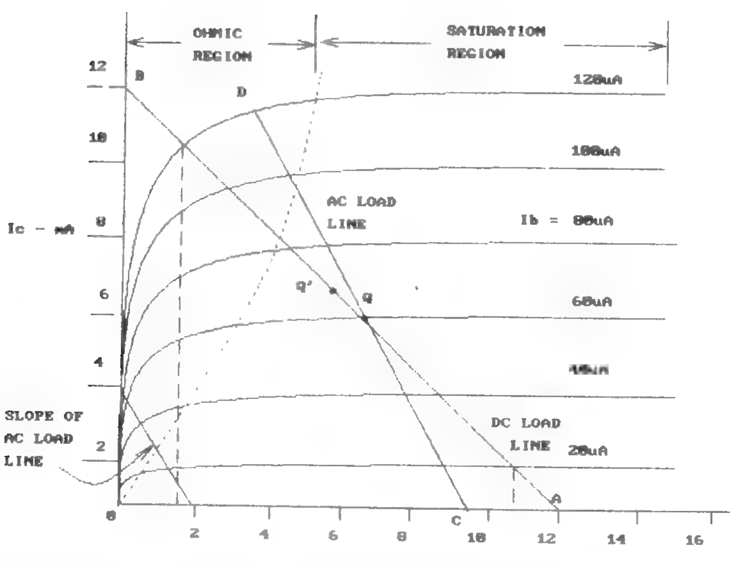

FIGURE 2: Load Line Construction

which means the transistor has a $\beta = 100$. Note that there is no emitter resistor, R_E, so the saturation current is $I_C = 12 \div 1000\ \Omega = 12$ mA.

The base bias resistor is calculated to be $12 \div 60uA = 200K$ which is a standard value (Although I said base bias is the poorest possible method of biasing, the concentration here is on the load lines and not the particular circuit). Some interesting points can be made by examining the DC load line (AQB) in FIGURE 2. First, at the extremes of the load line, the actual values of current and voltage become more and more non-linear. In other words, you can't drive the collector voltage over the full range of plus or minus 6 volts.

Near point B the base current lines are coming closer together which results in some distortion of the output signal. The same is true at point A since the distance from 0 uA to 20 uA of base current is much more crowded than the values above 20 uA. This means more distortion in both the top and bottom of the output waveform. In FIGURE 2 the vertical dashed lines which are drawn from the 120 uA and 20 uA base current lines down to the voltage scale, V_{CC}, show the maximum peak-to-peak swing you can expect from this circuit with some distortion at the higher collector current.

The total voltage swing goes from about 1.6 volts to 10.6 volts for a total of 9 volts peak-to-peak. The swing is -4.4 volts to +4.6 volts centered on 6 volts at Q. This swing is still a little unsymmetrical, and so you make a slight change in the position of Q on the load line to equalize the voltage swing by 0.1 volt so it becomes plus or minus 4.5 volts about Q. This means moving Q just slightly lower so the transistor draws just under 6 mA when no signal is present. This then, is a way to choose an operating current based upon the saturation cwrent for a given supply voltage and load resistance. But you're not done yet, for you must deliver this signal to a load.

THE AC LOAD LINE

In my first installment, I talked about a schematic actually being two schematics - an AC (or signal) schematic, and a DC schematic - at the same time. There is a reason I did it that way. Things change when you add the next stage to your first stage. You have now paralleled the input impedance of the second stage with the load resistor of your first stage. This changes the *AC load* seen by the first stage and thereby changes the *AC operating conditions* which means a new load line is necessary.

In FIGURE 3 the load seen by the stage is 1 KΩ -- I've shown it as resistor R for simplicity. This means as far as the signal is concerned the collector load is now 500 ohms, since the load resistor, R, is in parallel with the 1000 Ω collector resistor, R_L (I've called the parallel combination of the two r_L). The AC load line must pass through point Q since at zero signal - or where the signal crosses zero - the DC conditions prevail if only momentarily. The slope of the AC load line will be steeper since the paralleled resistances are less than either value.

The slope of this new load line can be calculated mathematically, but I'll show you an easy way to do it graphically. First, pick a voltage that is less than the supply voltage and mark it on the voltage scale. In FIGURE 2 I picked 2 volts. Calculate the current that would flow through rL at this voltage. Since $r_L = 500\ \Omega$, the current is then $2 \div 500$ or 4 mA. Mark this on the current scale. A line drawn between these two points has the same slope as the AC load line.

Now use a ruler and triangle to transfer this same slope to a line through the Q point. FIGURE 2 shows both the slope line in the lower left corner and the AC load line (CQD) drawn on the characteristic curves. If a signal is applied the operating point now moves up and down the *AC load line*. This new AC load line shows that somewhat less output voltage swing is available than with the DC load line. The swing goes from about 3.5 volts to about 9.2 volts centered on 6 volts.

Note that the plus or minus voltage swing is still not symmetrical. and you need to make a new Q point - called Q' - and draw a new AC

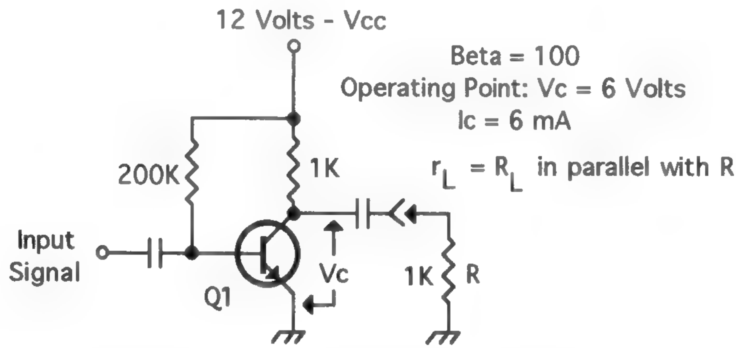

Figure 3: Base Bias Amplifier for Load Line Example

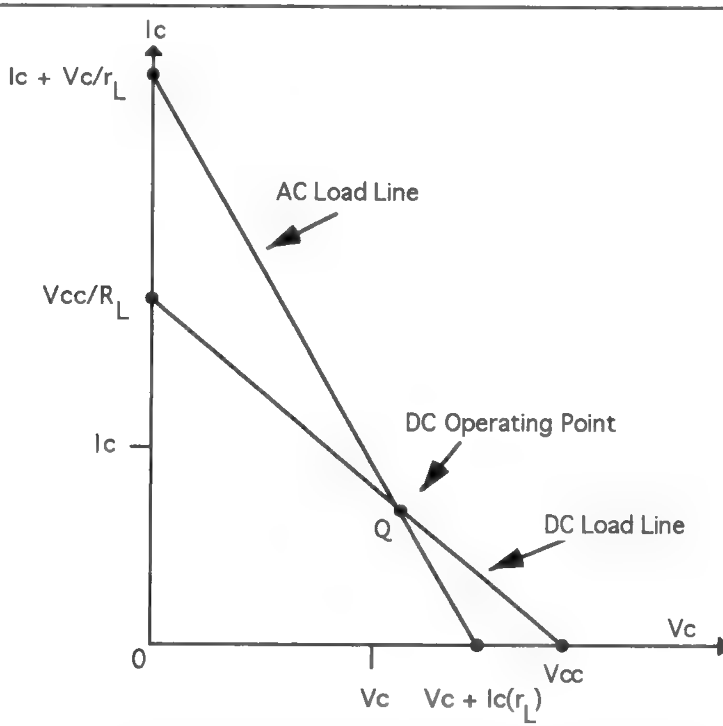

Figure 4: Load Line Analysis Without Curves

load line through it. By iterating this process one or more times, you will find a new Q' which will give a maximum output signal that is as symmetrical as possible. If you do this experimentally it can go much faster. In FIGURE 3, simply lower the base resistance, R_B, and observe the output signal on an oscilloscope until you have no clipping on either the top or bottom of the signal.

If you don't have access to an oscilloscope, you can get an idea from a simple AC voltmeter. Put the voltmeter on the output and raise the input signal until the voltmeter no longer reads an increase in output proportional to the increase in input signal. when this occurs you have reached the maximum signal capability of the stage. Backing off the input signal to where it responds to small changes in the input signal will be close to the maximum signal output of the amplifier. But today there are no curves available to do this type of load line analysis.

DESIGNING WITHOUT CURVES

Can you do load line analysis if you don't have a set of characteristic curves? Yes you can, but some of the more subtle aspects of analysis with the curves will not be as readily apparent. You may have to do a bit more experimentation on the stage to get things working properly. FIGURE 4 shows the load lines plotted on the same scales as before but without the characteristic curves.

In FIGURE 4, I have not put in the actual currents and voltages, but rather I have put in the Ohm's law equivalents so that you can calculate your own set of numbers when you try this technique. The DC load line is drawn as before, and the AC load line has the following intercepts on the voltage and current axes. The cutoff voltage for the AC load line is:

$V_C + I_C r_L$, and

the peak saturation current is:

$I_C + (V_C \div r_L)$

Clipping occurs when the signal tries to exceed ICrL on the positive portion of the waveform. If the negative peak tries to exceed VC, clipping will occur again.

Thus the maximum peak-to-peak signal - without clipping - is $2V_C$ or $2I_C r_L$. whichever is **smaller** for both common-emitter and common-base amplifiers. Again you can move the Q point so that the AC load line will have equal excursions on either side of it by making the collector current equal to:

$I_C = V_C \div (r_L + R_L)$.

Once again, all of the above equations are simply applications of Ohm's law. One of the advantages of graphical analysis using load lines is that you can see changes more easily and more quickly than you can by simply looking at mathematical equations. Next time I will talk about input and output impedances. and what you can do to adjust them so matching between outputs and inputs is a little easier. - W6VAT

(Continued from pg. 39)

REGISTRATION FEE

Registration for the QRP Symposium will be $30 if prepaid to Paulette N9OHU by May 1, 1996 and $35 if paid after that date or at the door. We may have to limit May 16, 1995 at-the-door registration if we are sold out of facilities. So please register early to guarantee a seat at this not-to-be-missed QRP event. Registration will cover full day Thursday QRP Symposium activities including the QRP presentations, the autographed world premier QRP Design Databook, the QRP Symposium Proceedings, the scrumptious QRP luncheon and finally the endless QRO coffee pot.

Please send your $30 (US cheque, money order) FDIM QRP Symposium Registration fee by May 1, 1995 to:

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CLASSIFIED ADS

A Reader Service of **Hambrew - No charge to subscribers** to place one ham-related ad per issue, limit 15 words, 25 cents per word thereafter. Commercial or non-commercial subscribers, no minimum. All ads must be related to amateur radio. **Hambrew** does not vouch for nor guarantee the reliability nor legitimacy of any item or company represented herein. Deadlines: Sept.1 (Autumn), Dec.1 (Winter), March 1 (Spring) June 1 (Summer). We reserve the right to deny publication of any ad. Copy To: PO Box 260083, Lakewood, CO 80226-0083. Sorry, no phone orders on classified ads. Prepay only.

Need Manual for Yaesu FT208R HT. If available, please xerox and send a copy. Will pay for costs. Ken Mahoney, K6OPG, 2036 Revere Ave. San Francisco, CA 94121, (415) 282-4807

CHASSIS AND CABINET KITS: #10 SASE 5120-H HARMONY GROVE RD., DOVER, PA 17315. 717-292-4901 EVENINGS

2N4416A FETs for sale. Prime/JAN devices in ESD pack 10/$6.00 PPD to KC5RT, 701 Oakridge, Liberty, MO 64068

The History of QRP in the U.S. 1924-60 by Ade Weiss K8EFG/WØRSP. 208 pages, 56 photos/16 illustrations-W1FB: "I recommend this book for your Amateur Radio library, even if you never become a member of the fast-growing QRP fraternity..." WB8UUJ:"something to warm the cold winter nights with good memories.." $12/lst Class ($10 Sen. Cits.) AdeWeiss, 526 N. Dakota St., Vermillion, SD 57069

Builders! Hard-to-find ceramic rotary switches. Ideal for bandswitching, antenna tuners, etc. Four wafers with single pole, five positions on each. Limited supply. $5 postpaid. Limit one per person. Unfilled orders returned. Fred Bonavita, W5QJM, Box 2764, San Antonio, TX 78299-2764

ELECTRONICS GRAB BAG! 500 PIECES OF NEW COMPONENTS: INDUCTORS, CAPACITORS, DIODES, RESISTORS. $5 POSTPAID. ALLTRONICS, 2300 ZANKER RD., SAN JOSE, CA 95131

Simple QRP Kits: Communications-Quality Receivers, Transmitters, Guaranteed to work! SASE for catalog: MXM Industries, Rt 1, Box 156C, Smithville, TX 78957 (512) 237-3906

WANTED: SERVICE MANUAL/SCHEMATIC FOR JFD MODEL 7200 FIELD STRENGTH METER. MARVIN MOSS, BOX 28601, ATLANTA, GA 30358

Wanted-HF WØZLN club station needs HF equipment reasonably priced or donated. Write University of Missouri Amateur Radio Club, A022 Brady Commons, Columbia, MO 65211

FOR SALE: TEN-TEC Argonaut II QRP XCVR, XLNT, $950/OBO. Call Bill, KJ6GR, (310) 542-9899

QRP Kits Available: Kanga, Hands Electronics, and KK7B designs $1 for catalog. Kanga US, Bill Kelsey, 3521 Spring Lake Dr.,Findlay, OH 45840 419-423-4604

K6LMN Simple Superhet Monoband Receivers: 80-10m. 6m converter. S.A.S.E. Roger Wagner, 1045 S. Manning Ave., Los Angeles, CA 90024, (310) 474-2447.

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